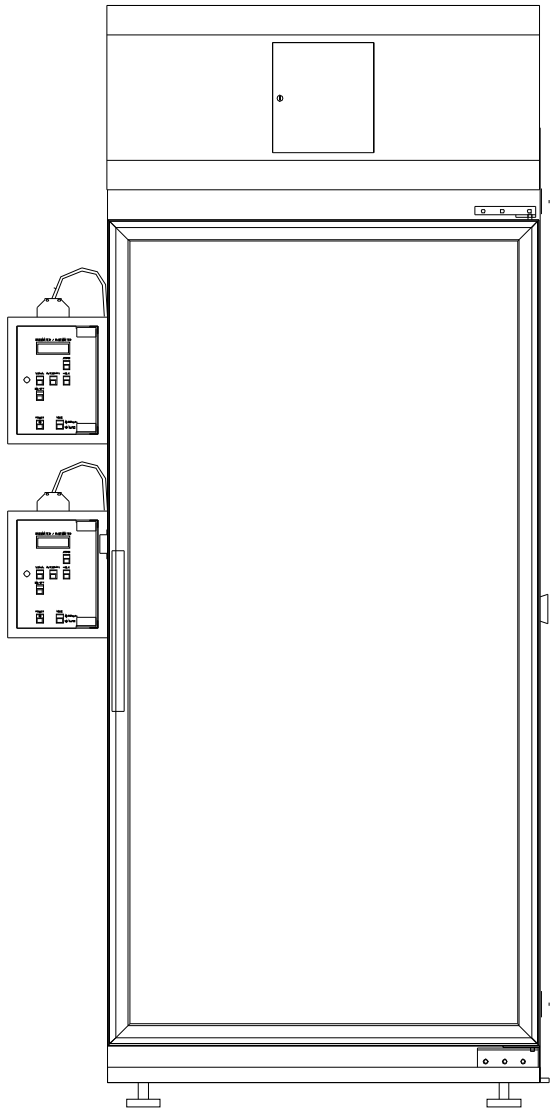
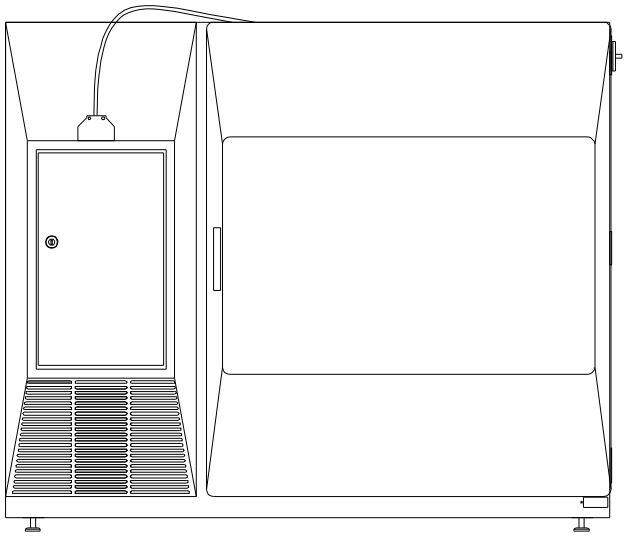
CARON 6500 SERIES
PHOTOSTABILITY TEST CHAMBERS





OPERATIONS MANUAL FOR
MODELS 6510, 6515, 6530 & 6535

TABLE OF CONTENTS

SECTION	PAGES
INTRODUCTION	3
INSTALLATION	4
OPERATION	10
Light meter	10
Light meter example	14
Temperature & Humidity controllers	15
Over temperature safety	16
Computer communications	16
Humidity control calibration	16
Chart recorder	17
Condensate recirulating system	17
Motorized turn table	18
MAINTENANCE	19
Replacement parts	20
APPENDIX	21
Terminology	21
Example	22
Controller default settings	24
Chart recorder default settings	28

INTRODUCTION

CARON's 6500 series photostability chambers are designed specifically to meet ICH and FDA requirements for photostability testing. Near UV and visible light testing is performed simultaneously using D65 lamps according to ICH Q1B option 1.

Calibrated photon detectors measure relevant lamp intensity on the product shelf. Lamp intensity (W/m^2 or Lux) and exposure level ($W\text{-}hr/m^2$ or Lux-hr) are conveniently displayed at eye-level by a calibrated digital light meter. After a programmed exposure level is reached the lamps automatically shut-off. To enhance reliability, temperature and humidity (optional) conditions are monitored and controlled throughout the photostability test.

SPECIFICATIONS

Lamp type	Fluorescent, D65
UV intensities, typical	1.5 W/m^2 (requires about 133 hours to achieve ICH recommendation of 200$W\text{-}hr/m^2$)
VIS intensities, typical	10 klux (requires about 120 hours to achieve ICH recommendation of 1.2 million lux-hr)
Temperature Range	15 – 40°C
Temperature Control	± 0.3°C

Features	**6510**	**6515**	**6530**	**6535**
Relative humidity range	-	*30 – 75%	-	*30 – 75%
Humidity control	-	± 5%	-	± 5%
Shelves, # of	1	1	2	2
Light meter, # of	1	1	2	2
UVA light detector, # of	1	1	2	2
VIS light detector, # of	-	1	-	1
Electrical power (60Hz)	115V 20A	115V 20A	115V 25A	115V 25A
Shipping weight, lbs	475	475	900	900
Options / Accessories				
Circular chart recorders Records:	REC-202 Temperature Light meter	REC-203 Temperature Humidity Light meter	REC-203 Temperature Light meter 1 Light meter 2	REC-204 Temperature Humidity Light meter 1 Light meter 2
UVA light detector	LGT-202			
VIS light detector	LGT-203			

* Humidity range limited by 5°C minimum dewpoint

Light intensity will vary based on model number, lamp age, chamber temperature, shelf height and shelf location. Models 6510 and 6515 will have lower intensities than models 6530 and 6535.

Chamber ambient conditions 20°C to 25°C. Exceeding 25°C can result in chamber failure.

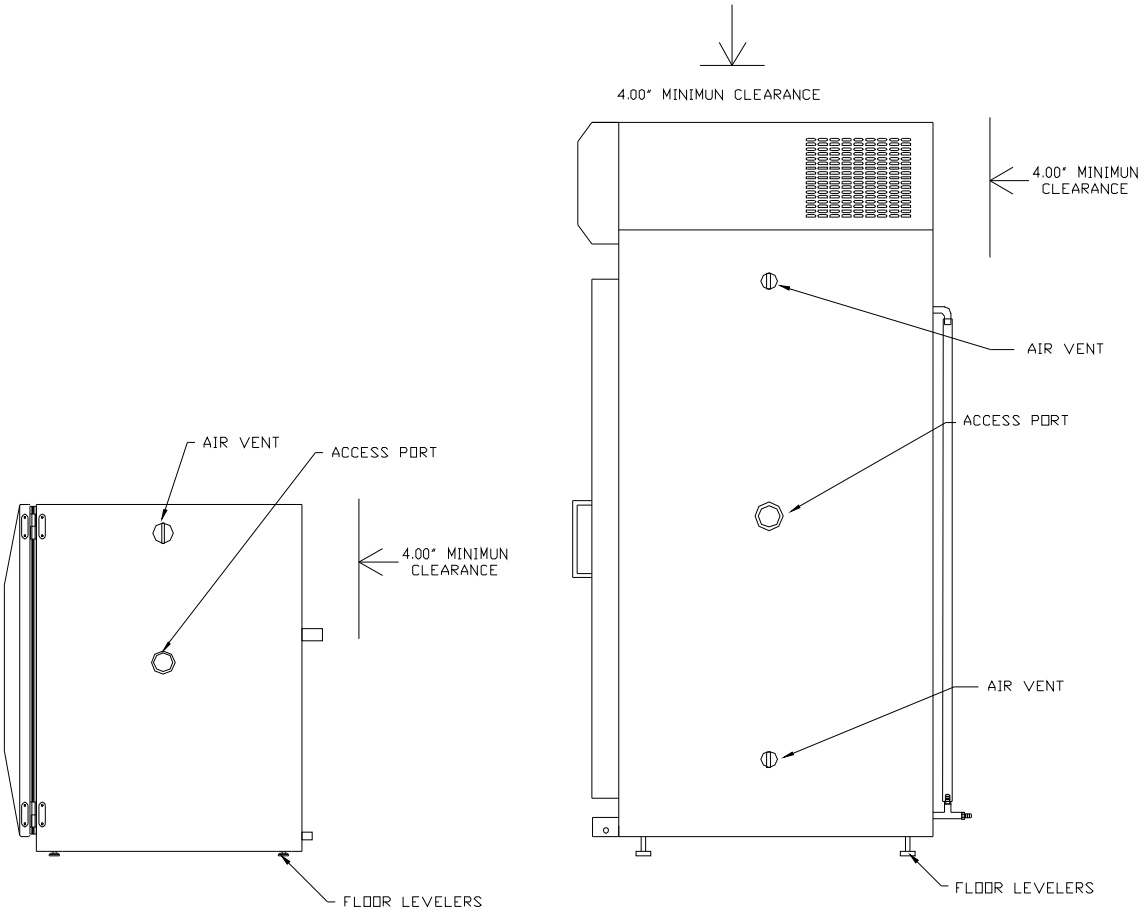
INSTALLATION

Unpacking

This product has been completely tested, cleaned and packed for shipment. Carefully remove all packing material. Please examine the chamber completely. Should any damage be found, notify the delivering carrier immediately.
Report any shortages to Customer Service at **1-740-373-6809**.

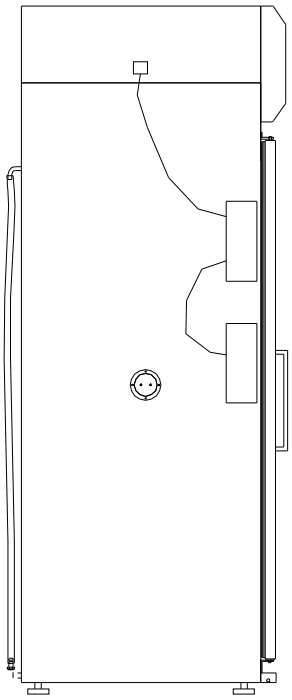
Chamber Location

Chamber ambient conditions 20°C to 25°C. Exceeding 25°C can result in chamber failure.
The chamber must be located in a dry, clean, and level area. Allow a 4" clearance from the back and top of the chamber for proper air circulation and ease of installation. Locate the chamber in an area out of direct sunlight and away from heating and cooling ducts. The figure below shows a side view of the chamber with air vent and access port locations.



Light control boxes ***(6530 & 6535 only)***

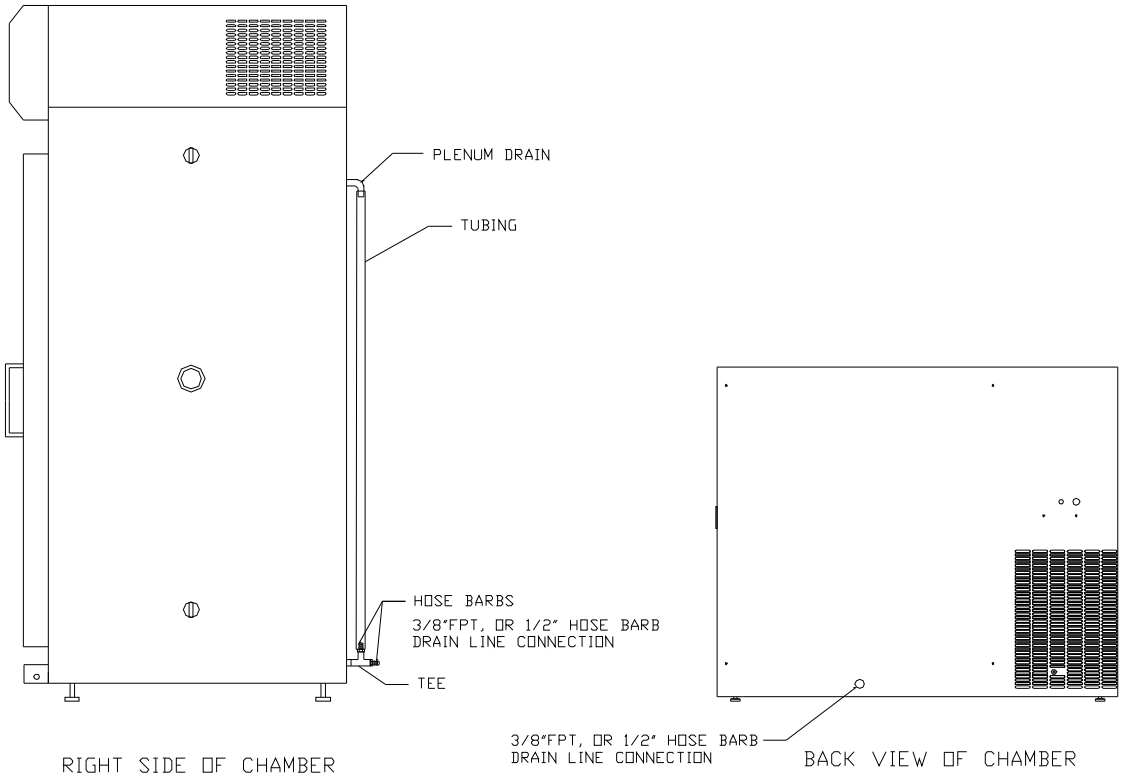
Mount the two light control boxes on the left side of the chamber. Mount the light control box with the longer cord on top. (See picture to right.) Connect the boxes to the chamber using the mounting screws already screwed into the chamber. Tighten the screws so that the boxes are held securely.



Connect the upper box's line cord into the receptacle mounted on the side of the chamber. Connect the lower box's line cord into the receptacle on the upper light control box.

Drain connection ***(6515 & 6535 only)***

Connect a 3/8" NPT drain line to the drain connection located on the lower back side of the chamber. The figure below shows the drain connection on the back of the chamber. For proper operation the drain hose should not be kinked or bent. It should run down from the chamber and go into an open floor drain.



Water supply ***(6515 & 6535 only)***

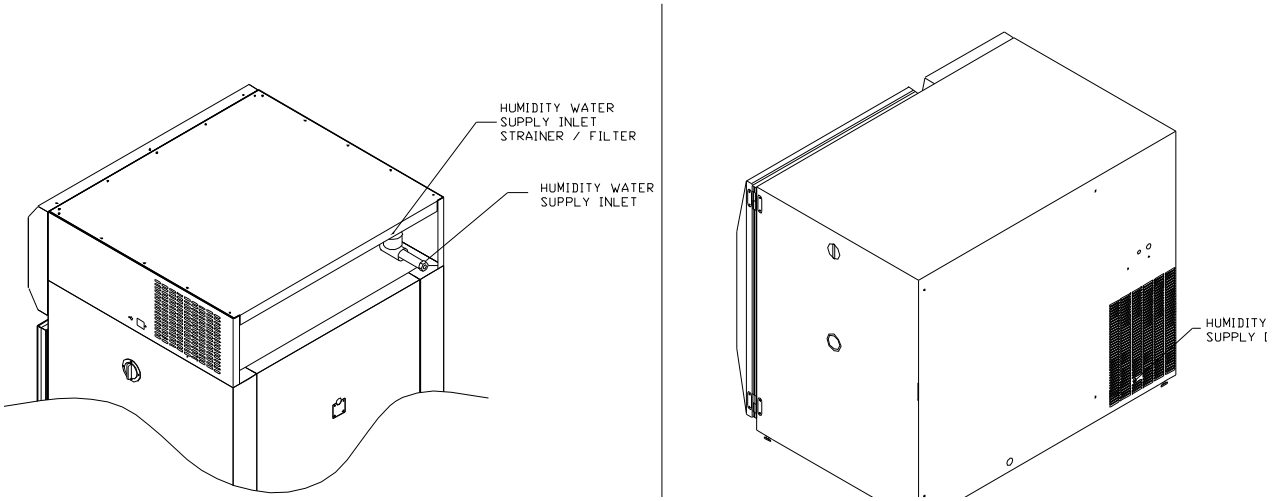
Connect a 3/8” NPT drain line to the drain connection located on the lower back side of the chamber.

Model 6535: Facing the back there is a water connection in the upper right hand corner. The ¼” compression – ¼” MPT fitting is attached to a filter/strainer and pressure regulator that is set at 40 PSI. The compression fitting can be removed to adapt to another type of ¼” MPT fitting.

Model 6515: The back side there is a water connection in the lower right hand corner. The ¼” compression fitting is attached to a filter/strainer and pressure regulator that is set at 40 PSI.

NOTE

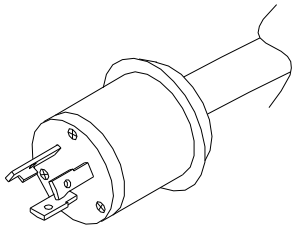
Use only distilled or deionized water with resistivity between 50kW-cm & 1 MW-cm and pH above 6.5. Using water outside this range will void the warranty.



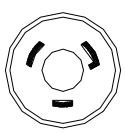
WARNING!
For personal safety, this chamber must be properly grounded.

Power

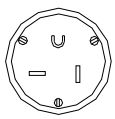
The Power Cord of this chamber is equipped with a grounded plug which mates with a corresponding outlet to minimize the possibility of electrical shock from the chamber. CARON recommends that the chamber have a dedicated wall outlet. Models 6510 & 6515 have a 20 amp plug (right picture) and models 6530 & 6535 have a 30 amp plug (left picture).



(NEMA L5-30) 30 AMP TWIST LOCK PLUG
HUBBELL #2611



(NEMA L5-30) 30 AMP TWIST LOCK RECEPTACLE
HUBBELL #2610A,LEVITON #2610 OR EQUIVALENT



(NEMA 5-20P) 20 AMP PLUG
HUBBELL #HBL5366C

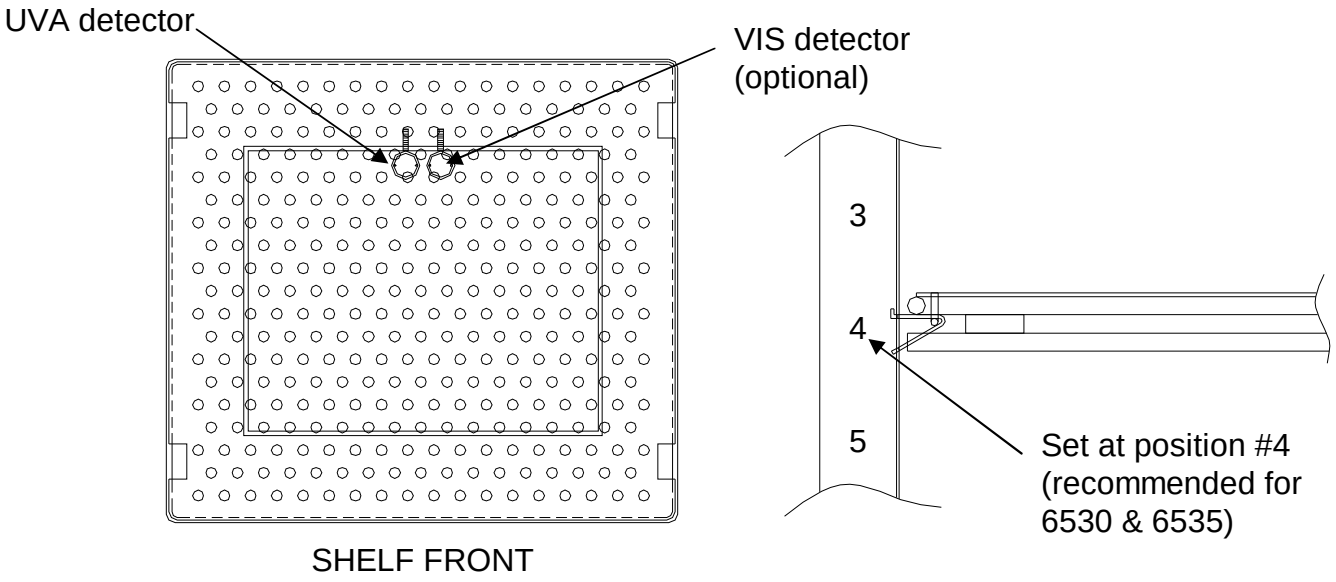
(NEMA 5-20R) 20 AMP RECEPTACLE

Install Lamps

Install the fluorescent lamps above each shelf. Insert bi-pin (longer) lamps into the lamp holders and rotate a ¼ turn. Mount the high output (shorter) lamps by pressing the one end into the plunger and then into the fixed end. If one lamp in not installed properly or burned out, it will affect the performance of other lamps.

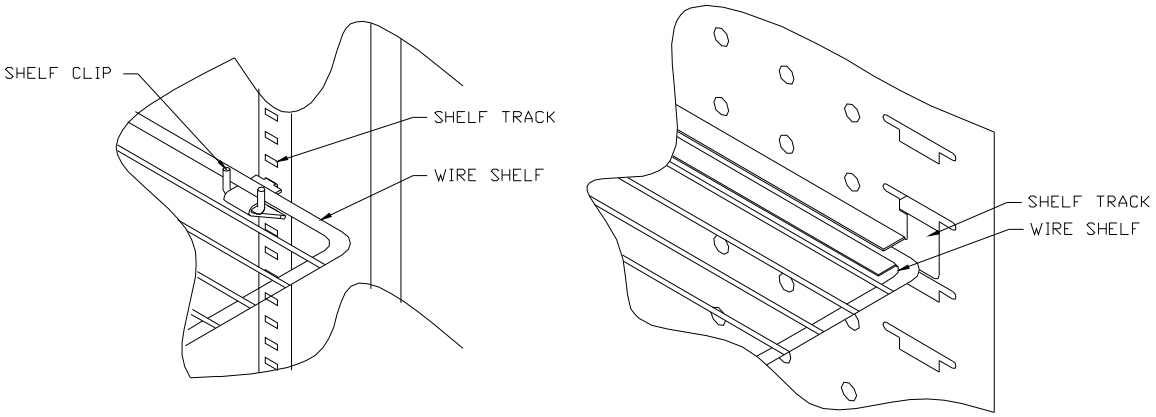
Mount Detectors

Mount one UVA detector to the top of each shelf and fasten with two screws though the shelf underside. The detector lends (white or clear) should be 'up' with the cable towards the 'back'. Mount the VIS detector (optional) next to the UVA detector in the same manor.



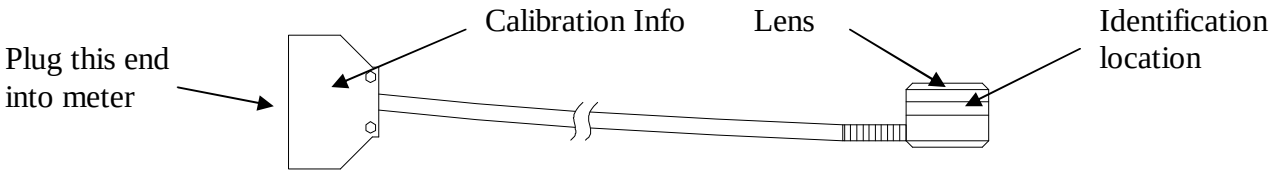
Install Shelves

Insert shelf clips into position #4 (recommended for 6535 & 6535) and shelves. Check to see if they are properly installed. (Wire shelves show below, actual unit may have perforated)

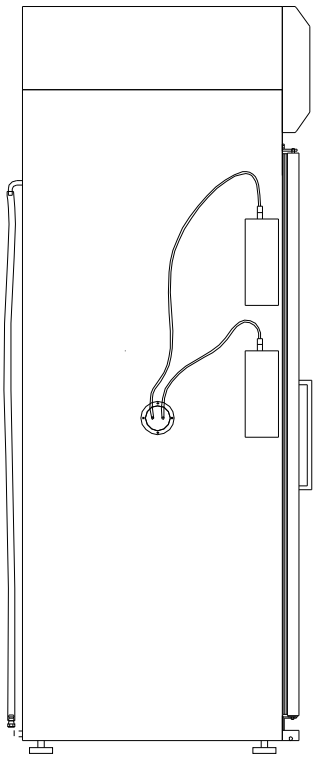


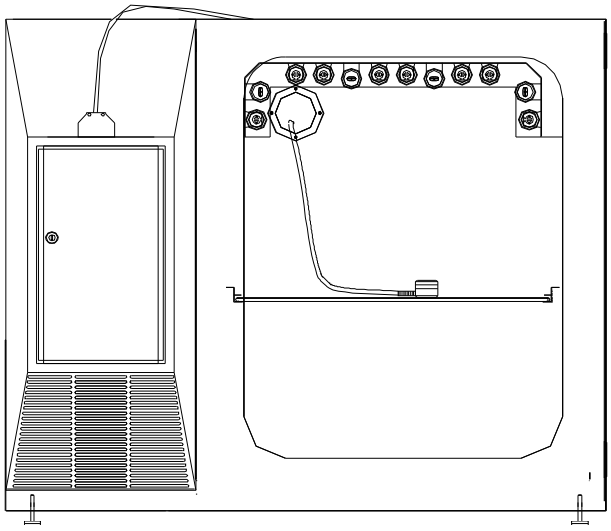
Detectors

A UVA detector (pictured below) is supplied with each shelf. Some models also come with VIS detectors or can be purchased separately. The UVA detector is identified with “TD” & “UVA” markings and has a white lens while the VIS detector has markings “Y” and “W” with a clear lens.



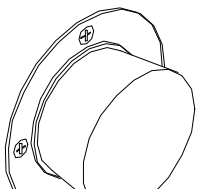
Attach the detector(s) to the shelf with two screws so the lends faces up. Route the cable through the 3” port on the back (6510 & 6515) or right side (6530 & 6535). Plug the detector into the meter as shown. For models with more than one shelf, plug the upper shelf into the upper light meter box and the lower shelf into the lower box. When in use, remove the black dust cover from over the detector lens. Since the lens is fragile, re-install the dust cover when not in use.





Port

Install foam plug to cover 3” detector port. Place rubber stopper in 2” access port on right side of

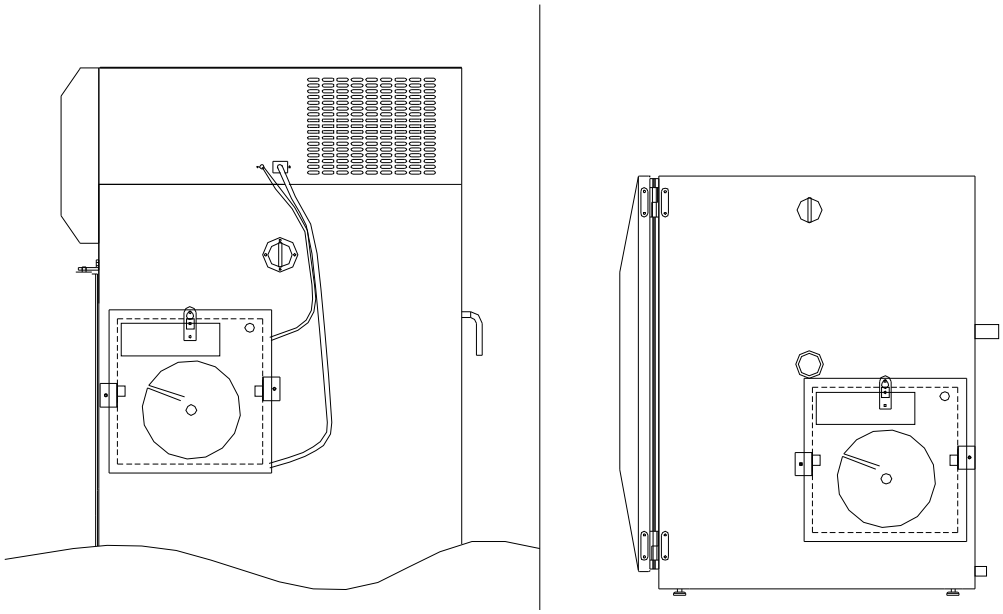


cabinet (see picture). Close both fresh air ports (right side of cabinet, top & bottom) by screwing them clockwise.

CIRCULAR CHART RECORDER, REC-202, -203, -204 (OPTIONAL)

The Honeywell DR 4500 Truline Circular Chart Recorder uses reliable microprocessor operation to generate dependable traces on thermal 12-inch circular charts. Refer to the Chart Recorder's User's Manual to change the chart speed settings for various chart speeds.

Mount the recorder by using the already installed bracket.
There are three factory drilled holes located on the right side of chamber facing the front of



chamber. Using the factory supplied screws, screw the recorder to the side of the chamber.

Locate both wire cords coming out of the chart recorder and plug them into the corresponding connectors on the chamber

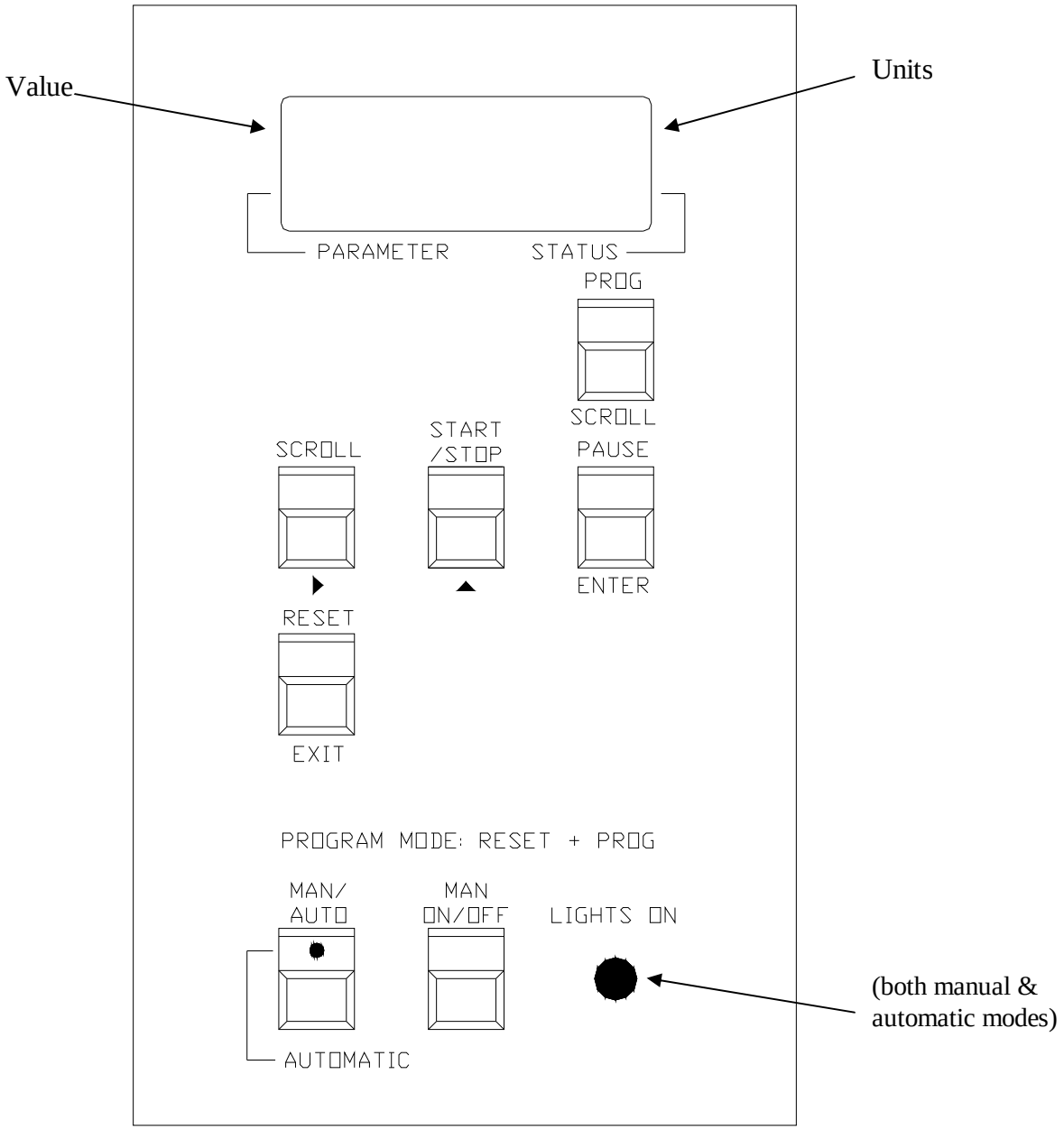
NEVER ATTEMPT TO ACCESS COMPONENTS INSIDE
THE RECORDER CASE WITH POWER APPLIED.

OPERATION

Light Control

Each light bank (shelf) is individually controlled in either manual or automatic mode. In manual mode, the MAN ON/OFF button turns the lights on & off. In automatic mode, the lights turn on when an exposure is started and off automatically at the end (START/STOP button). Press MAN/AUTO to toggle between the two modes.

The light meter buttons and screen features of the are illustrated below.



Light Meter Modes

There are five different light meter modes. The current light meter mode flashes in the status portion of the display (lower right side).

READY	View intensity & other variables and ready to start an exposure or test
EXPOSE	Exposure or test is running
PAUSE	Exposure or test is paused
COMPLT	Exposure or testing is complete
Program	Exposure level maybe programmed and calibration parameters read

READY Mode

In the READY mode, the following functions can be done:

1. View variables (press the SCROLL button)

INTENSITY	measured light intensity for connected light detector. If the UVA detector is plugged in, it will display the UVA intensity in units of W/m^2. If the VIS detector is plugged in, it will display the VIS intensity in units of lux.
TIME LFT	length of time a test would take given the current INTENSITY and EXP LVL
INTNSTY2	estimated light intensity for the detector *not* currently plugged in. If a UVA detector is plugged in, then this displays the estimated VIS intensity in units of lux. If the VIS detector is plugged in, then this displays the estimated UVA intensity in units of W/m^2. These values are only estimated and should be verified by the appropriate detector!
EXPLVL	current exposure level displayed in units corresponding to current detector

2. Start exposure or test (press the START/STOP button)

EXPOSE Mode

Expose or test mode is intended to keep the lights on for a specified exposure level and then automatically shut them off. This only works if the light meter is in the automatic mode, not manual! To enter the EXPOSE mode, press the START/STOP button in the READY mode.

In the EXPOSE mode, the following functions can be done:

1. View variables (press the SCROLL button)

INTENSITY	measured light intensity for connected light detector in W/m^2 or lux.
EXPOSE 1	total light exposure for connected light detector in $W\text{-}hr/m^2$ or lux-hr accumulated since starting the exposure or test.
TIME LFT	length of time remaining until exposure or test is complete

INTNSTY2 estimated light intensity for the detector *not* currently plugged in (lux or W/m^2). These values are estimated and are provided only as a guideline!

EXPOSE 2 estimated total light exposure for detector *not* currently plugged in (lux-hr or W-hr/m^2) accumulated since starting the exposure or test.

EXPLVL current exposure level displayed in units corresponding to current detector

2. Stop exposure or test (press the START/STOP button)
3. Pause current exposure or test (press the PAUSE button). This turns off the lights. However, the meter still monitors intensity and exposure levels.

PAUSE Mode

Pressing the PAUSE button during an exposure or test turns off the lights. Pressing the PAUSE button again turns the lights back on and resumes the exposure or test. While the lights are off, the meter still functions by measuring light intensity and computing the exposure level.

COMPLT

After an exposure or test is complete, COMPLT will flash in the status section of the display. The lights will have automatically shut off. Press the START/STOP button to return to the READY mode.

PROGRAM Mode

PROGRAM mode is used to change the exposure level (EXPLVL) and set the VIS to UVA ratio or OFFSET. It can also be used to view calibration information about the light detector. In program mode, the buttons take on different features as identified by the red characters underneath the button. Enter the PROGRAM mode by pressing the RESET button immediately followed by the PROG button. Press the *red* SCROLL button again to view the first variable.

Scroll through the variables by pressing the SCROLL (red) button.

EXPLVL displays current exposure level in exponential notation and units consistent with attached detector. The cursor flashes at the current digit. The **ù** button increments the digit. Use the ÷ button to move to the next digit. Once the desired value is displayed, press the ENTER button. To abort the entry, press the EXIT button (also exits PROGRAM mode). Factory default EXPLVL is 2.00 e+2 for the UVA detectors and 1.20e+6 for the VIS detectors.

SERIAL NUMBER shows the serial number of the attached detector (protected).

UNITS SELECT shows the units (intensity) for the attached detector (protected). The UVA detector will display W/m^2 while the VIS detector will display lux. The upper left corner displays the instantaneous intensity reading. A “dn” or “UP” displayed in the lower right corner is for factory purposes only.

FACTOR	displays factory calibration factor of attached detector (protected). The upper left corner displays the instantaneous intensity reading.
CALIBRATION DATE	shows the day, month and year the attached detector was last calibrated (protected).
OFFSET	displays the estimated ratio of the UVA to VIS detectors (protected). See offset calibration below for more details.

OFFSET (VIS to UVA ratio)

Since only one detector maybe connected to the meter at a time, only UVA or VIS can be measured without physically changing detectors. However, there maybe situations where it would be beneficial to know what the other detector would read if it were attached. This can be done using the OFFSET feature.

For a specific geometric location (position on shelf and shelf height) and lamp age, there is a given VIS & UVA ratio. This ratio can be entered into the light meter and both VIS & UVA readings will be displayed without disconnecting the detector.

WARNING:

Moving the detector in any way will affect this ratio. It is imperative that it be check & interpreted properly.

Detector OFFSET values as supplied from the factory are 1.739e-4 for UVA and 5.751e+3 for VIS.

The table below suggests typical detector OFFSET values for each shelf height with the detectors properly mounted.

Shelf Position	6530 & 6535	
	UVA	VIS
1	2.040 e-4	4.903 e+3
2	1.813 e-4	5.517 e+3
3	1.848 e-4	5.412 e+3
*4	1.739 e-4	5.751 e+3
5	1.669 e-4	5.993 e+3
6	1.660 e-4	6.023 e+3

* Factory default values

Procedure for using the UVA detector to display accurate VIS readings:

1. Plug the UVA detector in and locate it as desired
2. Record the INTENSITY reading (ex: 2.25 W/m^2)
3. Plug the VIS detector in and locate it *exactly where the UVA detector was located!!*
4. Record the INTENSITY reading (ex: 12,000 lux)
5. Calculate the UVA / VIS ratio (ex: 1.875e-4 = 2.25 W/m^2 / 12,000 lux)

6. Enter PROGRAM mode (press RESET + PROG)
7. Press the SCROLL button until SERIAL NUMBER is displayed
8. WARNING: Screens displayed beyond this point are locked to prevent accidental changing of detector calibration information. To unlock the screens, push the ù button until the left digit displays 4. Then press the ENTER button. Push the ù button until the display shows 8 and press the ENTER button a second time. This action will unlock all screens. Accidental changing of the calibration information can be re-entered from the calibration certificate provided with the detector.
9. Press the SCROLL button until OFFSET is displayed
10. Use the ù & ÷ buttons to enter the UVA / VIS ratio (ex: 1.875e-4)
11. Store the value by pressing the ENTER button
12. Exit PROGRAM mode by pressing EXIT

Now for the detector location, INTNSTY2 and EXPOSE2 will display VIS values even when the UVA detector is attached. To use the VIS detector to display UVA readings, repeat the above steps switching the two detectors and inverting the ratio (ie. OFFSET = VIS / UVA).

EXAMPLE – PROGRAMING AN EXPOSURE LEVEL

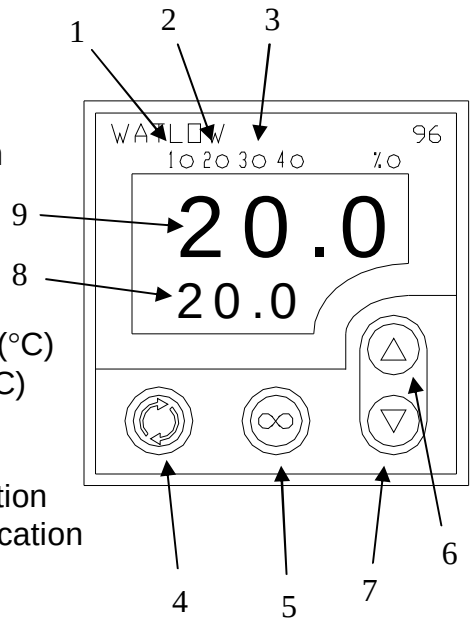
The following example shows how to program a UVA exposure level of 200 W-Hr/m^2 into the light meter.

1. Plug the UVA detector into the light meter
2. Press the RESET button; “READY” should flash in the status display area
3. Press the RESET button immediately followed by the PROG button; the screen should display “PROGRAM MODE, PRESS RESET TO EXIT”
4. Press the (red) SCROLL button; “EXPLVL” with a number and units will appear
5. Press the ù button (increment digits) and the ÷ button (move between digits) to change the value to 2.000e+02 (or 200 W-hr/m^2).
6. Press the ENTER button; screen changes to display “SERIAL NUMBER”
7. Press the EXIT button to return back to “READY” mode; “INTENSITY” will be displayed
8. Verify the programming was correct by pressing the (black) SCROLL button 3 times and “EXPLVL” appears.
9. The value listed should be 2.000e+02 W-hr/m^2

CONTROLLERS: Temperature & Humidity

For CARON Model 6030 Environmental Test Chambers that are equipped with Watlow 96 single point and ramping controllers, use appendix B for operating instructions and default controller settings.

Controller Layout



Temperature

1 - Output 1, indicates heating system
2 - Output 2, indicates cooling system
3 - Output 3, indicates temperature alarm
4 - “Advance” key
5 - “Infinity/Home” key
6 - “Up” key
7 - “Down” key
8 - Lower display, Setpoint Temperature (°C)
9 - Upper display, Actual Temperature (°C)

Humidity

1 - Output 1, indicates system humidification
2 - Output 2, indicates system dehumidification
3 - Output 3, Not used
4 - “Advance” key
5 - “Infinity/Home” key
6 - “Up” key
7 - “Down” key
8 - Lower display, Setpoint Relative Humidity (%RH)
9 - Upper display, Actual Relative Humidity (%RH)

The Output indicator lights on the controller are not continuously on. They are only on when the specific system is in operation.

Change Set Point

Use the up and down arrow push-buttons to obtain the desired setpoint temperature or humidity.

1. When power is turned on, an alarm will briefly sound and reset after a few seconds. Set the temperature controller to the desired temperature set point. Use the up & down arrow keys as necessary.

2. (*6515 & 6535 only)* Turn on the humidity switch. Set the humidity controller to the desired set point like in step 1.

Note:
Controller default settings are listed in the Appendix. See also the separate controller manual for more details.

During normal refrigeration operation, a soft “clicking” sound can be heard. This sound is the result of the solenoid control valves switching in the refrigeration system.

Controller Calibration / Offset

The following procedure outlines the steps for setting a temperature or humidity offset.

A. Press the up and down keys together for 3 seconds
B. Press the advance key until CAL1 is in the lower display
C. Press the up or down keys to obtain the desired temperature or humidity offset
D. Press the Infinity key to return to the home page

TEMPERATURE SAFETY ALARM

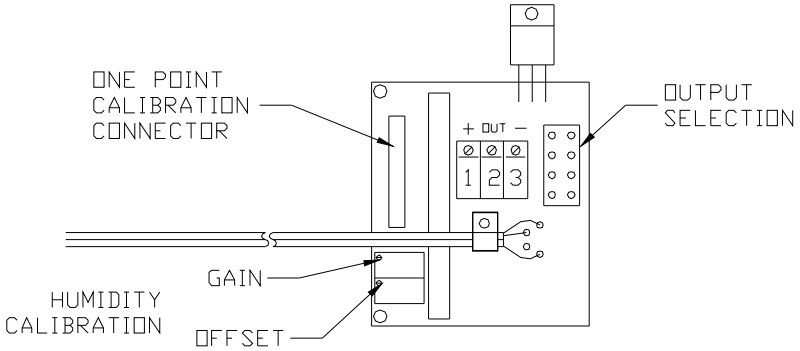
The temperature safety alarm is intended to alert the operator of an over-temperature condition. This would indicate inadequate internal cooling and should be rectified, as the chamber can get very hot with the lights on. This alarm will reset once the internal temperature has reached a safe level

COMPUTER COMMUNICATIONS

The temperature and humidity controllers are equipped with RS-485 computer communications for remote control or data logging. It is the customer’s responsibility to provide an RS-485 communications board or RS-485 to RS-232 converter for their PC and set up the system to accept data from the controllers. CARON can provide information about the type of RS-485 board and/or converter for your system. Terminations 11(R/T -), 12 (R/T +) and 13 (GND) located on the back of the chamber are used to connect for communications.

Humidity Controller Calibration

1. Remove the access panel located on the left (6510 & 6515) or top (6530 & 6535) of the chamber.
2. Find the 2” x 3” black utility box located adjacent to the wiring and in the service area.
3. Inside the utility box is the humidity module.
4. Slowly adjust the BOTTOM humidity calibration pot to the desired



HUMIDITY SENSOR
CALIBRATION
BOARD

calibration point as shown on the humidity controller readout.

CHART RECORDER (OPTIONAL)

	6510	6515	6530	6535
Recorder P/N	REC-202	REC-203	REC-203	REC-204
# of inputs/channels	2	3	3	4
Channel #1	Temperature	Temperature	Temperature	Temperature
Channel #2	Light meter	Light meter	Light meter 1	Light meter 1
Channel #3		Humidity	Light meter 2	Light meter 2
Channel #4				Humidity

Recorder pens are the same for all recorders and are configured as listed below

Pen 1 Temperature
Pen 2 Light meter 1
Pen 3 Light meter 2
Pen 4 Humidity

Press the LOWR DISP button to scroll through the different channels.

Press the SETUP button to scroll through the group menus.
Press the FUNC button to scroll through a particular group.
Press the UP & DOWN arrow buttons to change the current parameter

To increment a numerical value, press & hold the UP arrow key. While holding the UP arrow key, press the DOWN arrow key to move cursor to the next digit location.

To decrement a numerical value, press & hold the DOWN arrow key. While holding the DOWN arrow key, press the UP arrow key to move cursor to the next digit location.

Replacing the chart: (DO NOT LIFT THE PENS DIRECTLY)

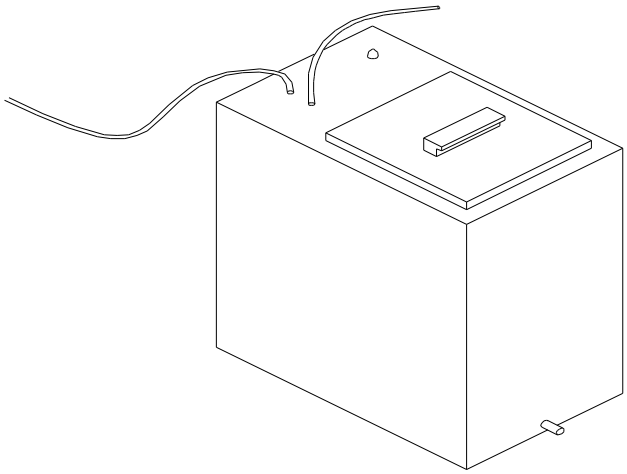
a) Turn the latch on the recorder door & open door
b) Press the CHART button & wait till the pen moves to edge of chart.
c) Pull up on the pen lifter to raise the pen from the chart plate. DO NOT LIFT THE PEN DIRECTLY.
d) Slip the new chart under the pen lifter and press the chart into place over the locating pin. Chart lettering should face you.
e) Push down the pen lifter to return the pen to the chart.
f) Press the CHART button to start recording
g) Close & latch the recorder door.

CAUTION: Be careful not to move the pen arm at any time or damage may occur.

See the Appendix for default controller settings and consult the Honeywell Recorder Manual for additional operation information.

CONDENSATE RECIRCULATING SYSTEM; CRS-101 (ACCESSORY)

The Condensate Recirculating System is used in conjunction with CARON's Series 6000 Test Chambers, as a water delivery system. This system is typically used in facilities where a floor drain or in-house source of distilled or deionized water are not available. The system provides continuous, clean, filtered water to the chamber's humidity injection system, collects and recycles the condensate that forms in the base of the chamber.

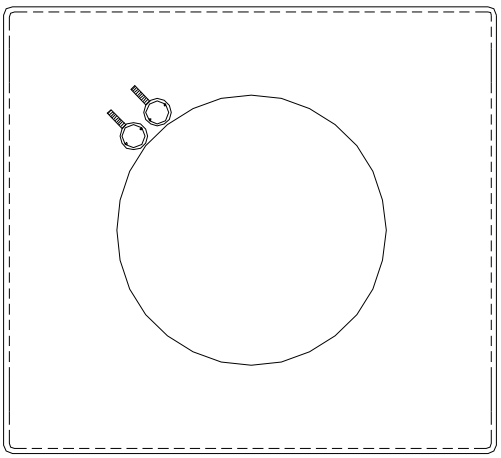


MOTORIZED TURN-TABLE; TBL-101 (OPTION)

The motorized turn-table is designed to significantly improve light uniformity by continually rotating the product. The motor's cord plugs into the internal outlet and rotates only when the lights are on. The table rotates gently at about 1 revolution per minute.

The tabletop rests on the shelf and spins on the keyed shaft. While running, it is recommended to locate the detectors at 10 O'clock from the center just beyond the table perimeter (see picture).

Note:
Averaging the four quadrant light intensity readings (12, 3, 6 and 9 O'clock) of the table while stationary approximates the light intensity of the table while being rotated. The lowest intensity over the table area is at the perimeter. Therefore, locating the detectors off the table (as shown in picture) such that the intensity approximates the 'perimeter four quadrant average' provides a good



FRONT (top view)

measure of the lowest light exposure on the rotating table surface.

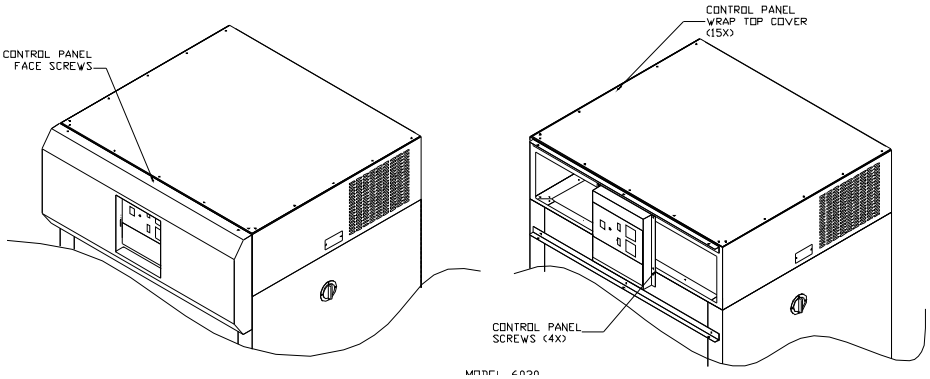
MAINTENANCE

CONTROL PANEL ACCESS MODEL 6530 & 6535

WARNING: Before removing control panel, disconnect all power!

The access to all control panel and top mounted electrical parts, refrigeration parts as follows:

a) The control panel components can be easily accessed by removing the (6) screws located at the top, and bottom of the control housing cover.
b) Pull the front mounted control housing cover towards you to access the control



panel.

c) Next remove the (4) screws that hold the control panel housing in place, and the housing will be loose.
d) In order to access the electrical and refrigeration components, remove the sheet metal screws that are holding the top cover in position.

CONTROL PANEL ACCESS MODEL 6510 & 6515

WARNING: Before removing control panel, disconnect all power!

To access all control panel, electrical parts, and refrigeration parts this can be
Done by removing the (2) screws located at the top of the service panel, and pulling the panel out of it's slot.

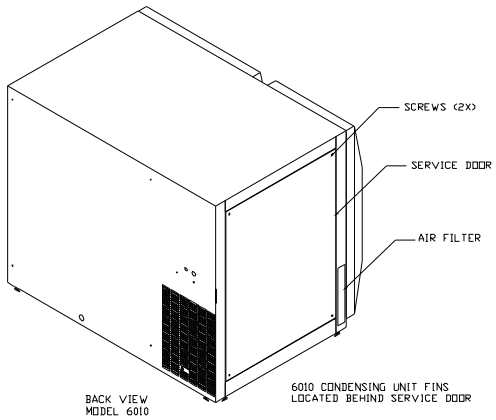


Chart Recorder
The recorder does not require any periodic maintenance. However, the chart will have to be replaced as required. The chart paper can be ordered directly from Honeywell PH# 1-800-423-9883 (USA & CANADA) PN# 30755317-001.

CHAMBER MAINTENANCE SCHEDULE

a) Replace lamps after 5000 hours of usage (*not* covered under warranty)
b) Vacuum or blow out condensing unit fins. (Monthly)
c) Clean interior chamber stainless steel with a non abrasive glass cleaner.
d) Check air filter (Model 6510 & 6515), replacement filters can be ordered through Caron Service Dept. 740-373-6809. (Monthly)

MODELS 6515 & 6535 only

e) Check drains in floor, rear cabinet and drip trough for blockage. (Monthly)
f) Using a level, check to maintain ½ of a bubble tilt to the back of the chamber for proper water drainage. (Every 6 Months)
g) Clean out water filter for humidity water inlet. (Monthly)
h) Check condensate drip pan located inside of 6010 (Every 3 Months), remove service door, lower right hand corner

REPLACEMENT PARTS / OPTIONS

LGT-111 Fluorescent D65 24 inch F20T12/65 bi-pin lamps (set of four). Lamps are 23.75" end to end.

LGT-124 Fluorescent D65 24 inch F24T12/D/HO high output lamp (individual) Lamps are 21.75" end to end.

LGT-202 UVA light detector detects the amount of incident UVA light and connects to chamber light meter via a 7 foot cable. Includes calibration traceable to N.I.S.T.

LGT-203 VIS light detector detects the amount of incident VIS light and connects to chamber light meter via a 7 foot cable. Includes calibration traceable to N.I.S.T.

PPR-201 Chart recorder paper (thermal), 12" circular, 100 count, Honeywell brand (for use with REC-202, REC-203 & REC-204)

SHV-108 Stainless steel perforated shelf for *models 6530 and 6535 only*

SHV-109 Stainless steel perforated shelf for *models 6510 and 6515 only*

APPENDIX – PHOTOSTABILITY TERMINOLOGY

ICH Guideline	1.2million lux hours of visible light & 200W-hr/m2 of near UV radiation
Visible Light (VIS)	400 nm to 700 nm wavelength
Near UV (UVA)	320 nm to 400 nm wavelength
Spectral power distribution (SPD)	a plot of wavelength verses intensity
Radiant flux	total rate of electromagnetic radiation emitted from a source in units of Watts
Luminous flux	analogous to radiant flux except restricted to visible light in units of Lumens
Irradiance	total rate of energy of all wavelengths incident on a given surface area (W/m^2)
Illuminance	luminous flux per area for the visible spectrum given in lumens per m^2, or lux
Exposure	irradiance or illuminance over a specific amount of time in units of $W\text{-}hr/m^2$ or lux-hr
Dose	see exposure
VIS	see visible light
UVA	see near UV
SPD	see spectral power distribution
Intensity	rate of energy incident on a given surface area (see also irradiance and illuminance)

SI symbol	**Prefix**	**Multiplication factor**
T	tera	1 000 000 000 000 = 10^{+12}
G	giga	1 000 000 000 = 10^{+9}
M	mega	1 000 000 = 10^{+6}
k	kilo	1 000 = 10^{+3}
m	milli	0.001 = 10^{-3}
µ	micro	0.000 001 = 10^{-6}
n	nano	0.000 000 001 = 10^{-9}
p	pico	0.000 000 000 001 = 10^{-12}

Terms and units	**Near UV Region**	**Visible Region**
Source or power	Radiant flux, Watts	Luminous flux, Lumens
Intensity or incident radiation	Irradiance, W/m^2	Illuminance, $Lumens/m^2$=lux
Exposure or total dose	Irradiation, $W\text{-}hr/m^2$	Irradiation, lux-hr

Example:

A technician wants to perform photostability confirmatory testing according to ICH Q1B and FDA requirements by exposing samples to 1.2million lux-hrs (visible region) and 200W-hr/m^2 (UVA region) of light. With the UVA detector attached to the light meter, it reads an INTENSITY of 1.8 W/m^2 and INTNSTY2 of 12 Klux. Under these conditions, it will take 111 hours (200 / 1.8) to reach the desired UVA exposure and 100 hours (1,200,000 / 12,000) to reach the VIS exposure level. The limiting factor is the UVA requirement.

Option 1 (use UVA detector)

Calculate the UVA OFFSET ratio: 1.500 e-4 = (1.8 W/m^2 / 12000 lux)

Attach the UVA detector to the light meter and program the OFFSET ratio to 1.500 e-4. The INTENSITY reads 1.8 W/m^2 and INTNSTY2 shows 12 Klux. Program the EXPLVL to 2.000 e+2 W-hr/m^2 (or 200). Under TIME LFT, it tells how long the exposure or test will take and reads 111 hours.

Make sure the light meter is in Automatic mode (light on button lit) and press START/STOP to initiate the test. The lights will come on. EXPOSE 1 will start from zero and increase. The test will commence when EXPOSE 1 reaches the EXPLVL or 200 W-hr/m^2. TIME LFT shows the amount of test time remaining at the current rate of INTENSITY. EXPOSE 2 shows the *estimated* amount of VIS exposure already accumulated.

Option 2 (use VIS detector)

Calculate the VIS OFFSET ratio: 6.667 e+3 = (12000 lux / 1.8 W/m^2)

Attach the VIS detector to the light meter and program the OFFSET ratio to 6.667 e+3. The VIS exposure level must be set above 1.2 million lux-hours to achieve 200 W-hr/m^2 and specifically to run 111 hours. Program the EXPLVL to 1.332 e+6 lux-hrs (where 1.332 e+6 lux-hrs = 12,000lux * 111 hours). Under TIME LFT, it tells how long the exposure or test will take and reads 111 hours.

Make sure the light meter is in Automatic mode (light on button lit) and press START/STOP to initiate the test. The lights will come on. EXPOSE 1 will start from zero and increase. The test will commence when EXPOSE 1 reaches the EXPLVL or 1.332 Mlux-hr. TIME LFT shows the amount of test time remaining at the current rate of INTENSITY. EXPOSE 2 shows the *estimated* amount of UVS exposure already accumulated.

During testing, the testing maybe paused by pressing the PAUSE button. The lights will go off but the meter will remain active. Pressing the PAUSE button again will continue the test by turning the lights back on. The lights will automatically shut-off at the end of the specified exposure.

EXAMPLE – PROGRAMING AN EXPOSURE LEVEL

The following example shows how to program a UVA exposure level of 200 W-Hr/m^2 into the light meter.

1. PIug the UVA detector into the light meter.
2. Press the RESET button; “READY“ should flash in the status display area.
3. Press the RESET button immediately followed by the PROG button; the screen should display “PROGRAM MODE, PRESS RESET TO EXIT“
4. Press the (red) SCROLL button; “EXPLVL“ with a number and units will appear.
5. Press the > button (increment digits) and the < button (move between digits) to change the value to 2.000e+02 (or 200 W-hr/m^2).
6. Press the ENTER button; screen changes to display “SERIAL NUMBER“.
7. Press the EXIT button to return back to “READY“ mode; “INTENSITY“ will be displayed.
8. Verify the programming was correct by pressing the (black) SCROLL button 3 times and “EXPVL“ appears.

The value Iisted shouid be 200 W-hr/m^2

The following example shows how to program a VIS exposure level of 1.2 Mlux-hr into the light meter.

1. PIug the VIS detector into the light meter.
2. Press the RESET button; “READY“ should flash in the status display area.
3. Press the RESET button immediately followed by the PROG button; the screen should display “PROGRAM MODE, PRESS RESET TO EXIT“
4. Press the (red) SCROLL button; “EXPLVL“ with a number and units will appear.
5. Press the > button (increment digits) and the < button (move between digits) to change the value to 1.200e+06 (or 1,200,000 lux-h).
6. Press the ENTER button; screen changes to display “SERIAL NUMBER“.
7. Press the EXIT button to return back to “READY“ mode; “INTENSITY“ will be displayed.
8. Verify the programming was correct by pressing the (black) SCROLL button 3 times and “EXPVL“ appears.

The value Iisted shouid be 1.200 Mlux-hr

APPENDIX - WATLOW® CONTROLLER

Factory Set Parameters – Temperature

SETUP PAGE

Global Menu

Units Type	Unit	SI	
°C or °F	C-F	°C	
Input Error Latching	Err	nLAt	
Failure Mode	FAiL	bPLS	(not available with ramping)
Power Limit Set Point	PLSP	800	
High Pwr Lmt Above	PL A	100.0	
High Pwr Lmt Below	PL b	100.0	
Ramping Mode	rP	OFF	(not available with ramping)
Open Loop Detect	OPLP	off	
Program Type	PtYP	ti	(ramping only)

Input 1 Menu

Sensor Type 1	Sen1	rtd	
Input 1	In 1	din	
Range Low 1	rL 1	5.0	
Range High 1	rh 1	60	
Decimal 1	dEC1	0.0	
Input Software Filter1	Ftr1	-15.0	(6510/6515 is 1)

Input 2 Menu

Input 2	In 2	off	{2nd set point option: E In}
Event Function	E Fn	nonE	{2nd set point option: SP}
Event Condition	E cn		{2nd set point option: E In}

Output 1 Menu

Output 1	Ot 1	hEAt

Output 2 Menu

Output 2	Ot 2	COOL

Output 3 Menu

Output 3	Ot 3	AL
Alarm 3 Type	AtY3	dE
Alarm Hysteresis 3	AhY3	0.1
Latching 3	Lat3	no
Silencing 3	SiL3	no
Alarm Active Sides 3	Sid3	bOth
Alarm Logic 3	Lgc3	AL O
Alarm Annunciation 3	Anu3	no

Output 4 Menu

Baud Rate	bAUd	19.20
Address	Addr	1

OPERATIONS PAGE

User Menu

Auto-Manual Mode	A-M	Auto	(not available with ramping)
Auto-tune	Aut	OFF	
Auto-tune Set Point	AtSP	90	
Calibration Offset	CAL 1	0.0	

PID1 Menu

Propband 1	Pb 1	5.0	(6510/6515 is 4.6)
Integral 1	It 1	99.99	(6510/6515 is 9.50)
Derivative 1	dE 1	0.00	(6510/6515 is 2.3)
Burst 1	brS1	no	
Cycle Time 1	Ct 1	50.0	(6510/ 6515 is 1.0)
Dead Band 1	db 1	0.0	

PID2 Menu

Propband 2	Pb 2	4.6
Integral 2	It 2	10.00
Derivative 2	dE 2	2.3
Cycle Time 2	Ct 2	10.0
Dead Band 2	db 2	0.0

Alarm Menu

Alarm 3 Low	A3LO	-50
Alarm 3 High	A3hi	50

Factory Set Parameters – Humidity

SETUP PAGE

Global Menu

Units Type	Unit	SI	
Input Error Latching	Err	nLAt	
Failure Mode	FAiL	bPLS	(not available with ramping)
Power Limit Set Point	PLSP	50	
High Pwr Lmt Above	PL A	100.0	
High Pwr Lmt Below	PL b	100.0	
Ramping Mode	rP	OFF	(not available with ramping)
Open Loop Detect	OPLP	off	
Program Type	PtYP	ti	(ramping only)

Input 1 Menu

Sensor Type 1	Sen1	Proc	
Input 1	In 1	0- 5	
Range Low 1	rL 1	0	
Range High 1	rh 1	100	
Decimal 1	dEC1	0	
Input Software Filter1	Ftr1	2.0	

Input 2 Menu

Input 2	In 2	off	{2nd set point option: E In}
Event Function	E Fn	nonE	{2nd set point option: SP}
Event Condition	E cn		{2nd set point option: LO}

Output 1 Menu

Output 1	Ot 1	hEAt

Output 2 Menu

Output 2	Ot 2	COOL

Output 3 Menu

Output 3	Ot 3	AL
Alarm 3 Type	AtY3	dE
Alarm Hysteresis 3	AhY3	1
Latching 3	Lat3	no
Silencing 3	SiL3	no
Alarm Active Sides 3	Sid3	bOth
Alarm Logic 3	Lgc3	AL O
Alarm Annunciation 3	Anu3	no

Output 4 Menu

Baud Rate	bAUd	19.20
Address	Addr	2

OPERATIONS PAGE

User Menu

Auto-Manual Mode	A-M	Auto	(not available with ramping)
Auto-tune	Aut	OFF	
Auto-tune Set Point	AtSP	90	
Calibration Offset	CAL 1	0	

PID1 Menu

Propband 1	Pb 1	2
Integral 1	It 1	0.00
Derivative 1	dE 1	0.00
Burst 1	brS1	no
Cycle Time 1	Ct 1	4.0
Dead Band 1	db 1	0

PID2 Menu

Propband 2	Pb 2	6
Integral 2	It 2	0.00
Derivative 2	dE 2	0.02
Cycle Time 2	Ct 2	7.0
Dead Band 2	db 2	0

Alarm Menu

Dead Band 2	db 2	0
Alarm 3 Low	A3LO	-5
Alarm 3 High	A3hi	5

APPENDIX – CHART RECORDER

Factory set parameters

INPUT 1

INPUT 1	ENABLE	Input 1 actuation
DECIMAL	XXX.X	Decimal point location
UNITS	DEG C	Temperature Units
IN1 TYPE	100PT	Input 1 actuation type
IN1 HI	482.2	Input 1 high range value
IN1 LO	-184.4	Input 1 low range value
BIAS 1	0.0	Input 1 bias or offset
FILTER 1	0	Input 1 filter
BURNOUT	UP	Burnout protection

INPUT 2 (UVA note: 0W/m^2 = 0Vdc; 1W/m^2 = 1Vdc = 20%; 2.55Vdc is maximum)

INPUT 2	ENABLE	Input 2 actuation
DECIMAL	XXXX	Decimal point location
UNITS	XXXXX	Temperature units
ENGUNITS	PERCT	Engineering units
IN2 TYPE	0-5V	Input 2 actuation type
XMITTER2	LINEAR	Input 2 transmitter characterization
IN2 HI	100	Input 2 high range value
IN2 LO	0	Input 2 low range value
BIAS 2	0	Input 2 bias or offset
FILTER 2	0	Input 2 filter
BURNOUT	UP	Burnout protection

INPUT 3 (VIS note: 0klux = 0Vdc; 10klux = 1Vdc = 20%; 2.55Vdc is maximum)

	6510	6515	6530	6535
INPUT 3	DISABL	ENABLE	ENABLE	ENABLE
DECIMAL		XXXX	XXXX	XXXX
UNITS		XXXXX	XXXXX	XXXXX
ENGUNITS		PERCT	PERCT	PERCT
IN3 TYPE		0-5V	0-5V	0-5V
XMITTER3		LINEAR	LINEAR	LINEAR
IN3 HI		100	100	100
IN3 LO		0	0	0
BIAS 3		0	0	0
FILTER 3		0	0	0
BURNOUT		UP	UP	UP

INPUT 4

	6510	6515	6530	6535
INPUT 4	DISABL	DISABL	DISABL	ENABLE
DECIMAL				XXXX

UNITS				XXXXX
ENGUNITS				PERCT
IN4 TYPE				0-5V
XMITTER4				LINEAR
IN4 HI				100
IN4 LO				0
BIAS 4				0.0
FILTER 4				0
BURNOUT				UP

PEN 1

PEN1	ENABLE	Pen 1 record
PEN1IN	INPUT1	Pen 1 input
CHART1HI	50.0	Chart 1 high range value
CHART1LO	0.0	Chart 1 low range value
MAJORDIV	10	Major chart division
MINORDIV	10	Minor chart division
RNG1TAG	TEMP	Range 1 tag name

PEN 2 (UVA note: 0Vdc = 0% (0W/m^2); 2.5Vdc = full scale (2.5W/m^2))

PEN2	ENABLE	Pen 2 record
PEN2IN	INPUT2	Pen 2 input
CHART2HI	50.0	Chart 2 high range value
CHART2LO	0.0	Chart 2 low range value
MAJORDIV	10	Major chart division
MINORDIV	10	Minor chart division
RNG2TAG	LGT1	Range 2 tag name

PEN 3

	6510	6515	6530	6535
PEN3	DISABL	DISABL	ENABLE	ENABLE
PEN3IN			INPUT3	INPUT3
CHART3HI			50.0	50.0
CHART3LO			0	0
MAJORDIV			10	10
MINORDIV			10	10
RNG3TAG			LGT2	LGT2

PEN 4 (VIS note: 0Vdc = 0% (0klux); 2.5Vdc = full scale (25klux))

	6510	6515	6530	6535
PEN4	DISABL	ENABLE	DISABL	ENABLE
PEN4IN		INPUT3		INPUT4
CHART4HI		100.0		100.0
CHART4LO		0		0

MAJORDIV		10		10
MINORDIV		10		10
RNG4TAG		HUM		HUM

CHART

CHRTSPD	24 HR	Chart speed selection
TIME DIV	24	Time division
MINORDIV	FOUR	Minor division
CONTINUE	YES	Continue chart rotation
CHARTNAM	CARON	Chart name
HEADER	YES	Header for chart
REM CHRT	NONE	Remote chart activity

TIME

MINUTES	{current minutes of day}
HOURS	{current hour of day, of 24}
DAY	{current day of month}
MONTH	{current month}
YEAR	{current year}
DAY	{current day name}
WAKE MIN	00
WAKE HR	00
WAKE DAY	00
WAKE MON	01